

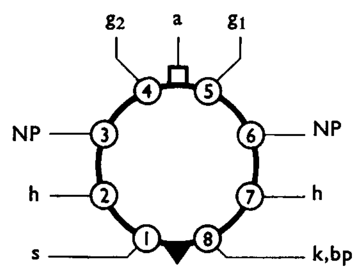
BEAM TETRODES

TT21 TT22

ISSUE 1

Beam tetrodes with oxide coated cathodes, the TT21 and TT22 are identical except for their heater ratings. They are designed for use as r.f. power amplifiers with full ratings at frequencies up to 30Mc/s and are also useful as audio output valves and pulse modulators.

BASE CONNECTIONS AND VALVE DIMENSIONS



Base: Octal
Bulb: Dome top tubular
Top cap: CT2
Max. overall length: 131mm
Max. seated length: 116mm
Max. diameter: 52mm

HEATER

	TT21	TT22	
V_h	6·3	12·6	V
I_h	1·6 (approx)	0·8 (approx)	A

MAXIMUM RATINGS (Absolute)

	*C.C.S.	†I.C.A.S.	
V_a	1·25	1·25	kV
V_a (I_a=0)	3·5	3·5	kV
V_{g2}	600	600	V
$-V_{g1}$	200	200	V
p_a	37·5	45	W
p_{g2}	6	6	W
p_{g1}	2	2	W
I_k	230	230	mA
$i_{k(pk)}$ (r.f.)	2	2	A
$i_{a(pk)}$ (pulse)	7·5	7·5	A
V_{h-k}	150	150	V
R_{g1-k} (fixed bias)	100	100	kΩ
R_{g1-k} (cathode bias)	220	220	kΩ
T_{bulb}	250	250	°C

*Continuous Commercial Service is defined as that type of service in which long life and reliability of performance under continuous operating conditions are the prime considerations.

†Intermittent Commercial and Amateur Service is defined as that type of service where minimum size, light weight and maximum power output are more important than long life.

Intermittent operation implies that no 'on' period exceeds 5 minutes and an 'on' period is followed by an 'off' period of the same or longer duration.

CAPACITANCES

c_{a-g1}: 0·25pF; $c_{g1-\text{all less a}}$: 17pF; $c_{a-\text{all less g1}}$: 13·5pF

MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED

Chelmsford, Essex, England · *Telephone: Chelmsford* 3221 · *Telex:* 1953 · *Telegrams: Expanse Chelmsford Telex*

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TT21
TT22

CHARACTERISTICS

V_a	250	V
V_{g2}	250	V
I_a	140	mA
g_m	11	mA/V
r_a	12	kΩ
μ_{g1-g2}	8	—

OPERATING DATA

A.F. POWER AMPLIFIER

The TT21 may be used as an alternative to the KT88 in any existing audio designs.

A.F. POWER AMPLIFIER—CLASS AB1—CATHODE BIAS

Push-Pull Ultra-Linear Connection with 43% Taps

Maximum Permissible Conditions—C.C.S.

$V_{a,g2}$	600	V
p_a	37·5	W
p_{g2}	6	W

Typical Operation

$V_{a(b)}$	500	V
$V_{a,g2}$	425	V
$I_{a+g2(o)}$	2×87	mA
$I_{a+g2(max)}$	2×100	mA
*R_k	2×525±5%	Ω
$v_{in(g1-g1)(pk)}$	90	V
$R_{L(a-a)}$	6	kΩ
P_{out}	50	W
D_{tot}	1	%

*Separate bias resistors essential.

A.F. POWER AMPLIFIER—CLASS AB1—FIXED BIAS

Push-Pull Ultra-Linear Connection with 43% Taps

Maximum Permissible Conditions—C.C.S.

$V_{a,g2}$	600	V
p_a	37·5	W
p_{g2}	6	W

Typical Operation

$V_{a(b)}$	560	V
$V_{a,g2}$	550	V
$I_{a+g2(o)}$	2×50	mA
$I_{a+g2(max)}$	2×150	mA
*$-V_{g1}$	80 (approx)	V
$v_{in(g1-g1)(pk)}$	120	V
$R_{L(a-a)}$	4·5	kΩ
P_{out}	100	W
D_{tot}	5	%

*Must be separately adjusted on each valve. Bias supply should have an adjustment range of ±25%.

When it is inconvenient to use either the TT21 or the KT88 in the ultra-linear connection, conditions similar to those given above may be used for tetrode connection. However, there is no advantage in setting the fixed screen voltage supply in excess of about 300V.

A.F. POWER AMPLIFIER—CLASS AB1—FIXED BIAS

Push-Pull Tetrode Connection—Intermittent Operation only

Maximum Permissible Conditions—I.C.A.S.

V_a	1·25	kV
V_{g2}	600	V
p_a	45	W
p_{g2}	6	W

Typical Operation

$V_{a(b)}$	1·25	kV
V_{g2}	300	V
$I_{a(o)}$	2×28	mA
$I_{a(max)}$	2×130	mA
$I_{g2(o)}$	<2×1	mA
$I_{g2(max)}$	2×13	mA
$R_{L(a-a)}$	15	kΩ
*$-V_{g1}$	45 (approx)	V
$V_{in(g1-g1)(pk)}$	71	V
P_{out}	200	W
D_{tot}	7	%

*Must be separately adjusted on each valve. Bias should have an adjustment range of ±25%.

R.F. POWER AMPLIFIER—CLASS C TELEGRAPHY

Maximum Permissible Conditions

	C.C.S.	I.C.A.S.	
V_a	1·25	1·25	kV
V_{g2}	600	600	V
$-V_{g1}$	200	200	V
I_a	200	200	mA
p_a	37·5	45	W
P_{in}	200	220	W
p_{g2}	6	6	W
p_{g1}	2	2	W

Typical Operation—C.C.S.

V_a	500	800	1000	1250	V
V_{g2}	300	300	300	300	V
$-V_{g1}$	115	115	115	115	V
I_a	192	182	175	160	mA
I_{g2}	20	20	20	20	mA
I_{g1}	8·5	7	5·5	4·5	mA
p_a	37·5	37·5	37·5	37·5	W
p_{g2}	6	6	6	6	W
P_{out}	58·5	108·5	137·5	162·5	W
Efficiency	61	75	78	81	%
*P_L	52	95	115	132	W
P_{out} (driver)	2·1	1·9	1·8	1·6	W

*Measured at 30Mc/s.

Typical Operation—I.C.A.S.

			*	*		
V_a	500	800	1000	1000	1250	V
V_{g2}	300	300	300	300	300	V
$-V_{g1}$	115	115	115	60	115	V
I_a	200	200	190	175	175	mA
I_{g2}	20	20	20	20	20	mA
I_{g1}	9	9	7·5	4	6	mA
p_a	40	43	45	45	45	W
p_{g2}	6	6	6	6	6	W
P_{out}	60	117	145	130	174	W
Efficiency	59	74	76·5	74·5	79·5	%
†P_L	52	103	126	106	146	W
P_{out} (driver)	2·1	2·1	2	0·65	1·9	W

*These operating conditions demonstrate the effect of reduced bias and driving power on power output.
†Measured at 30Mc/s.

R.F. POWER AMPLIFIER—CLASS C—ANODE MODULATED (Carrier Conditions)
Maximum Permissible Conditions

	C.C.S.	I.C.A.S.	
V_a	1	1	kV
V_{g2}	600	600	V
$-V_{g1}$	200	200	V
I_a	160	180	mA
p_a	25	30	W
P_{in}	130	150	W
p_{g2}	6	6	W
p_{g1}	2	2	W
Modulation	100	100	%

Typical Operation—C.C.S.

V_a	550	700	850	1000	V
V_{g2}	300	300	300	300	V
$-V_{g1}$	115	115	115	115	V
I_a	160	150	140	130	mA
I_{g2}	20	20	20	20	mA
I_{g1}	5	3·5	3	2·5	mA
p_a	25	25	25	25	W
p_{g2}	6	6	6	6	W
P_{out}	63·5	80	95	105	W
Efficiency	72	76	80	81	%
*P_L	54	70	82	87	W
P_{out} (driver)	1·5	1·4	1·2	1·1	W
P_{mod}	50	60	68	75	W

*Measured at 30Mc/s.

Typical Operation—I.C.A.S.

V_a	550	700	850	1000	V
V_{g2}	300	300	300	300	V
$-V_{g1}$	115	115	115	115	V
I_a	180	175	165	150	mA
I_{g2}	20	20	20	20	mA
I_{g1}	6·5	5·5	5	3·5	mA
p_a	30	30	30	30	W
p_{g2}	6	6	6	6	W
P_{out}	69	92	110	123	W
Efficiency	70	75·5	78·5	82	%
$*P_L$	61	82	94	101	W
P_{out} (driver)	1·8	1·7	1·5	1·2	W
P_{mod}	55	68	80	85	W

*Measured at 30Mc/s.

R.F. POWER AMPLIFIER—CLASS AB1—S.S.B.
Maximum Permissible Conditions

	C.C.S.	I.C.A.S.	
V_a	1·25	1·25	kV
V_{g2}	600	600	V
$-V_{g1}$	200	200	V
p_a	37·5	45	W
p_{g2}	6	6	W
p_{g1}	2	2	W

Typical Operation

V_a	800	1000	V
V_{g2}	300	300	V
$*-V_{g1}$	38	40	V
$v_{g1(pk)}$	38	40	V
$I_{a(o)}$	40	35	mA
$I_{a(max)}$	122	116	mA
$I_{g2(o)}$	0	0	mA
$I_{g2(max)}$	11	8·5	mA
$I_{g1(max)}$	0	0	mA
$p_{a(o)}$	32	35	W
$p_{a(max)}$	31	34·5	W
$p_{g2(o)}$	0	0	W
$p_{g2(max)}$	3·3	2·55	W
$\dagger P_{out}$	67	80	W
Z_a	2·8	3·6	kΩ
Efficiency	63	69	%
$\ddagger P_L$	55	65	W

*Adjust to obtain specified value of $I_{a(o)}$.
†Peak envelope power output or single tone power output.
‡Measured at 30Mc/s.

TT21
TT22

PULSE MODULATOR SERVICE

Maximum Permissible Conditions

V_a	3·5	kV
V_{g2}	600	V
$-V_{g1}$	200	V
p_a	37·5	W
p_{g2}	6	W
p_{g1}	2	W
$i_{a(pk)}$	7·5	A

Typical Operation

V_a	3·5	kV
V_{g2}	600	V
$-V_{g1}$	150	V
$v_{g1(pk)}$	380	V
$i_{a(pk)}$	6	A
$i_{g2(pk)}$	2·1	A
$i_{g1(pk)}$	2·3	A
R_a	460	Ω
t_p	2	μs
PRF	1500	p/s

INSTALLATION

The valve may be mounted either vertically or horizontally.

When a pair of valves is mounted vertically it is recommended that the centres of the valve sockets are not less than 4in. apart and that pins 4 and 8 of each valve are in line.

When a pair of valves is mounted horizontally it is recommended that the centres of the valve sockets are not less than 4in. apart and that pins 4 and 8 of each valve are in the same vertical line.

Free air circulation around the valve is desirable.

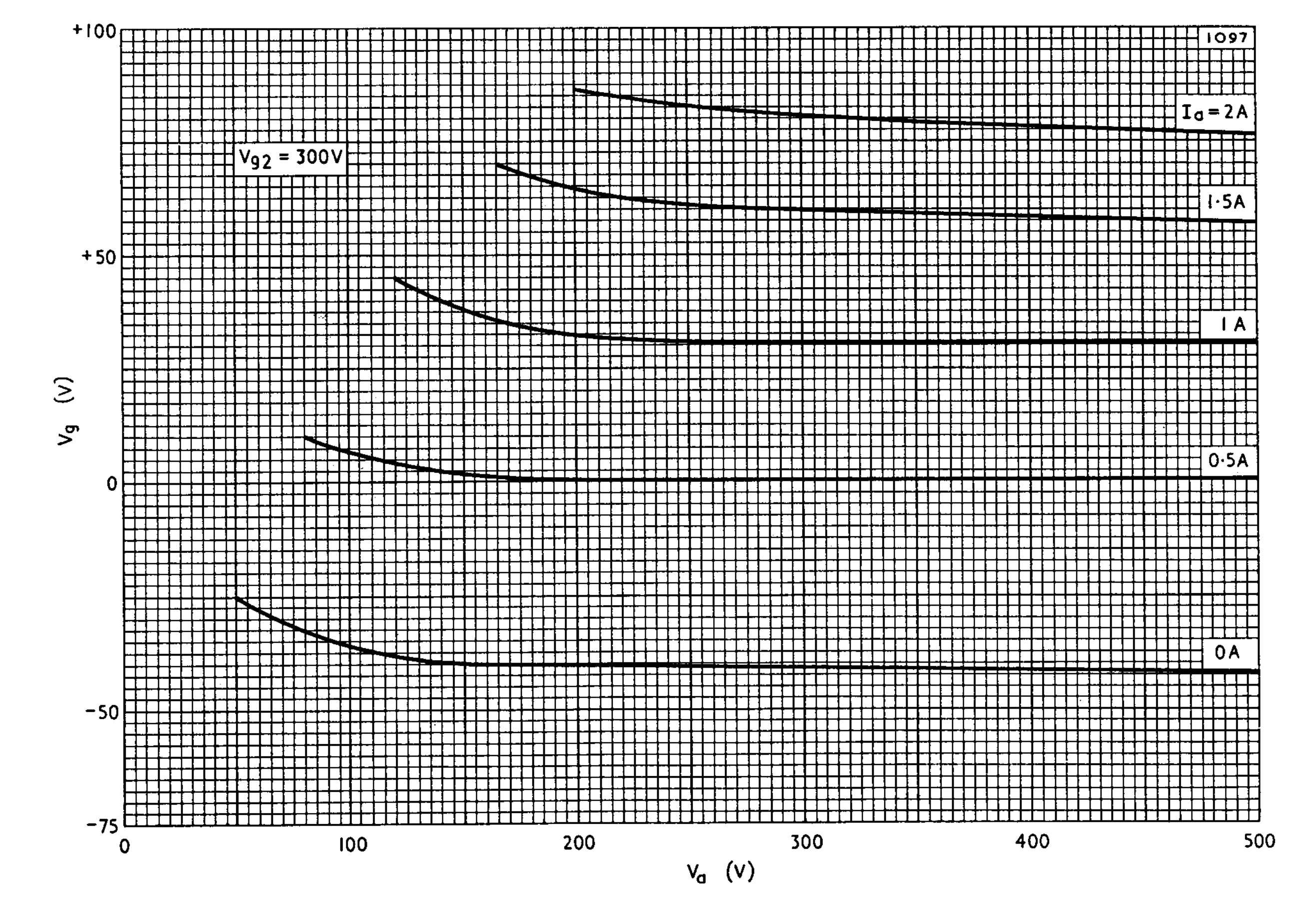


Fig. 1. Constant anode current curves at V_{g2} = 300V.

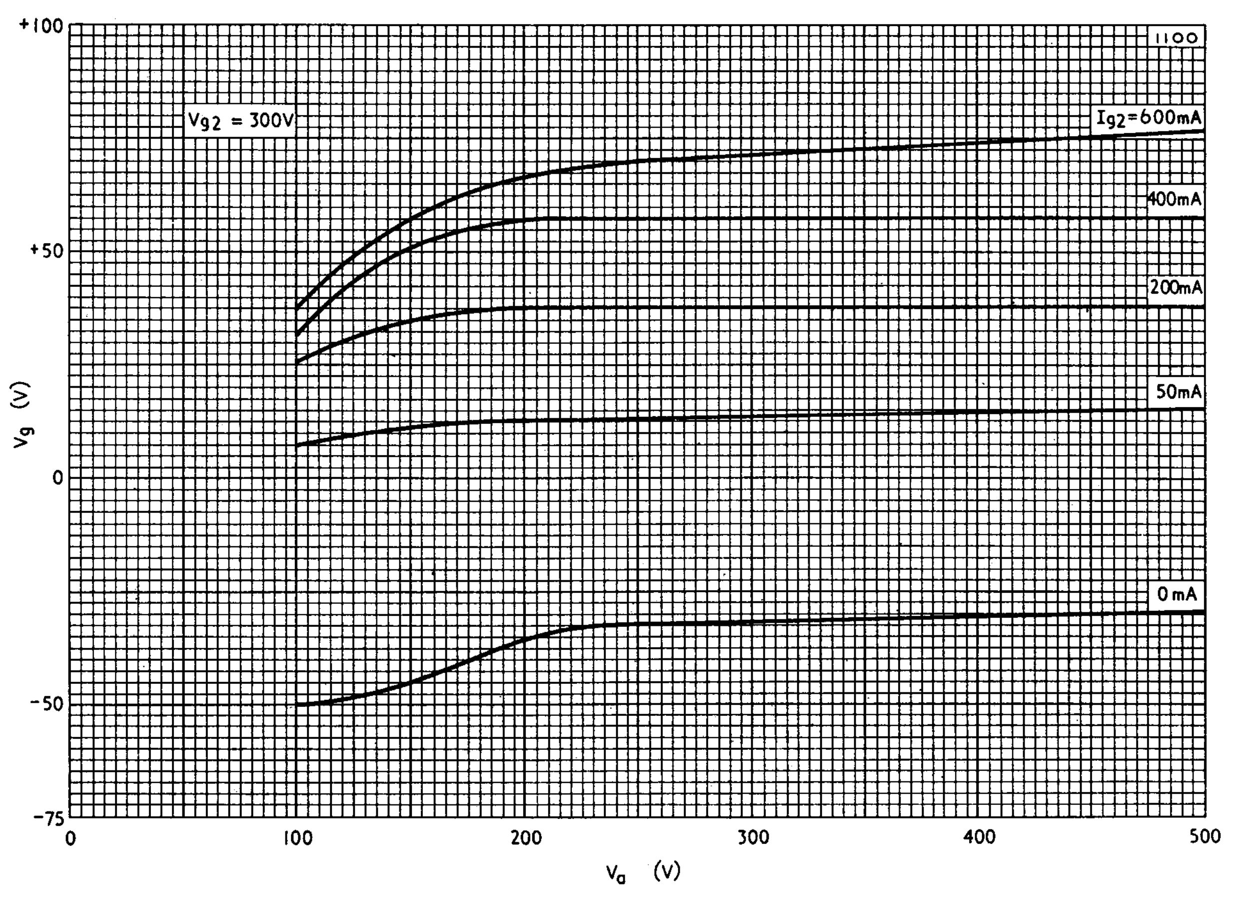


Fig. 2. Constant screen current curves at V_{g2}=300V.

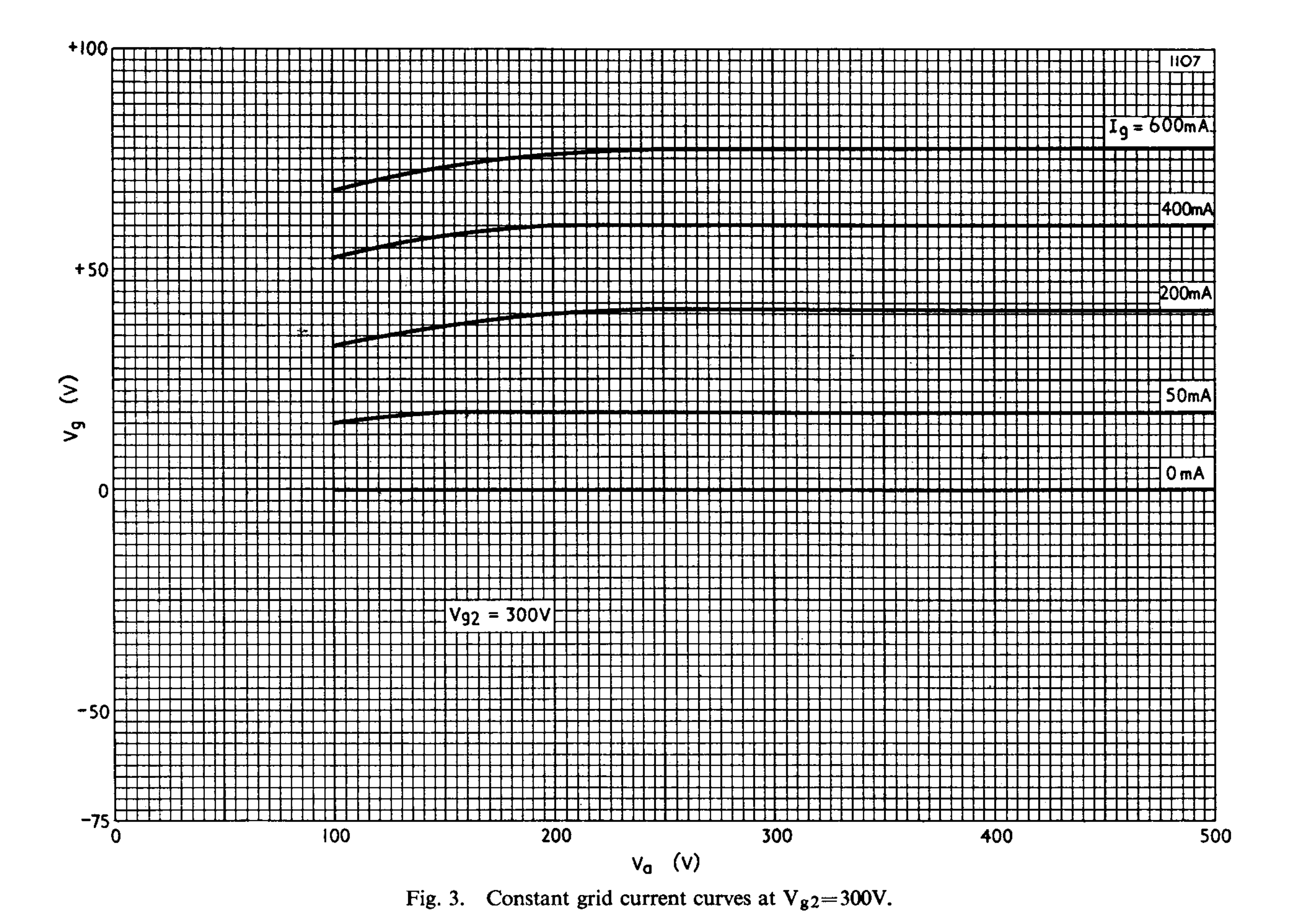


Fig. 3. Constant grid current curves at V_{g2}=300V.

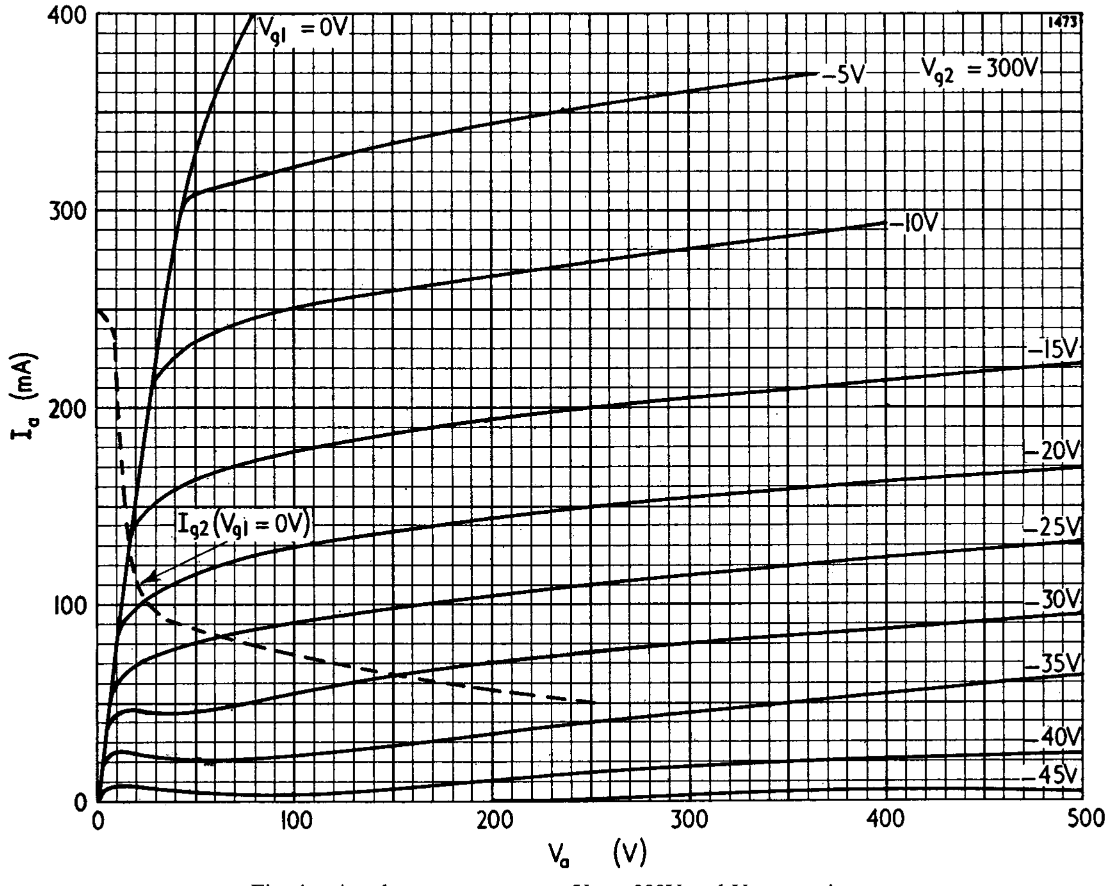


Fig. 4. Anode current curves at V_{g2} = 300V and V_{g1} negative.

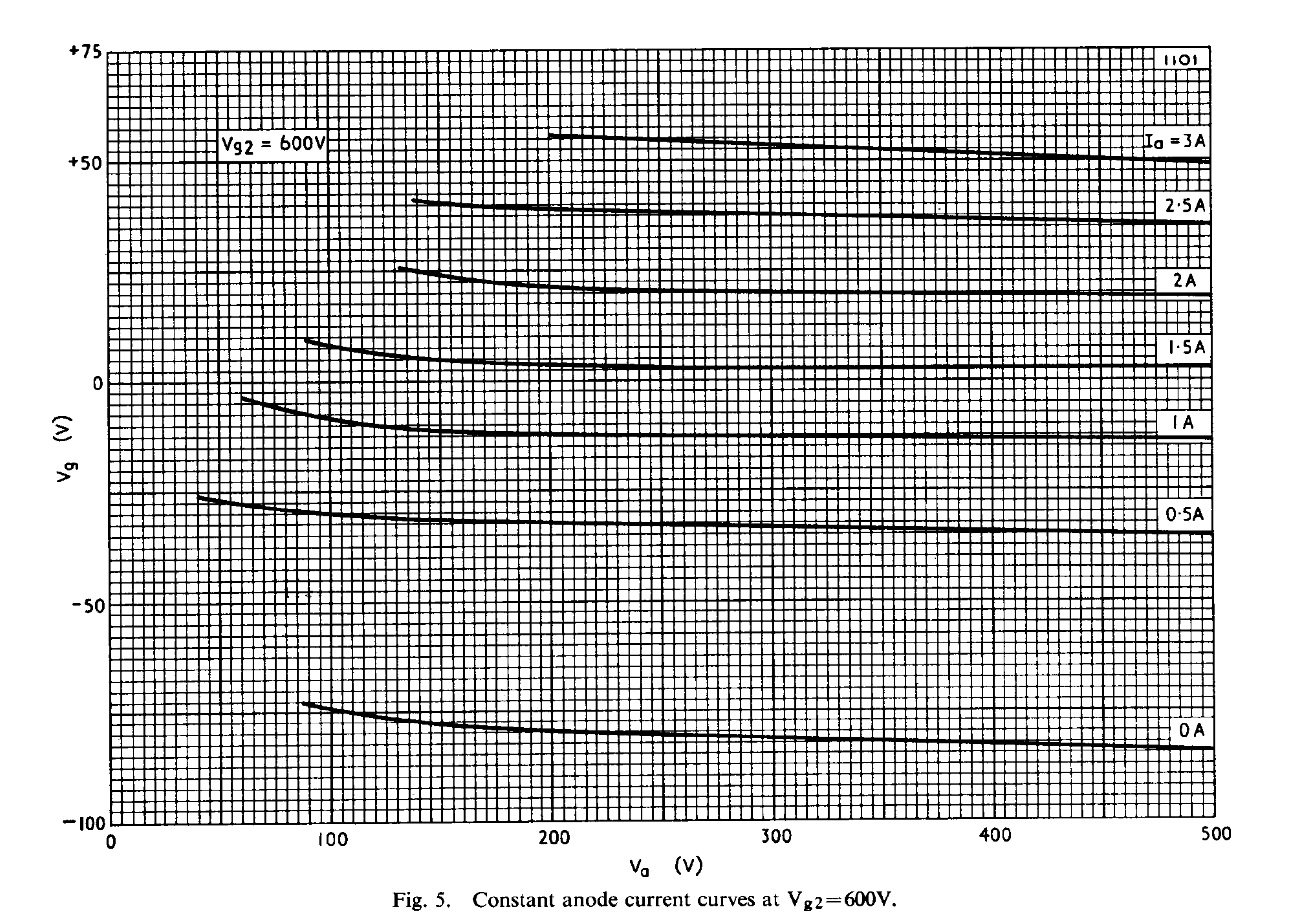


Fig. 5. Constant anode current curves at V_{g2}=600V.

TT21
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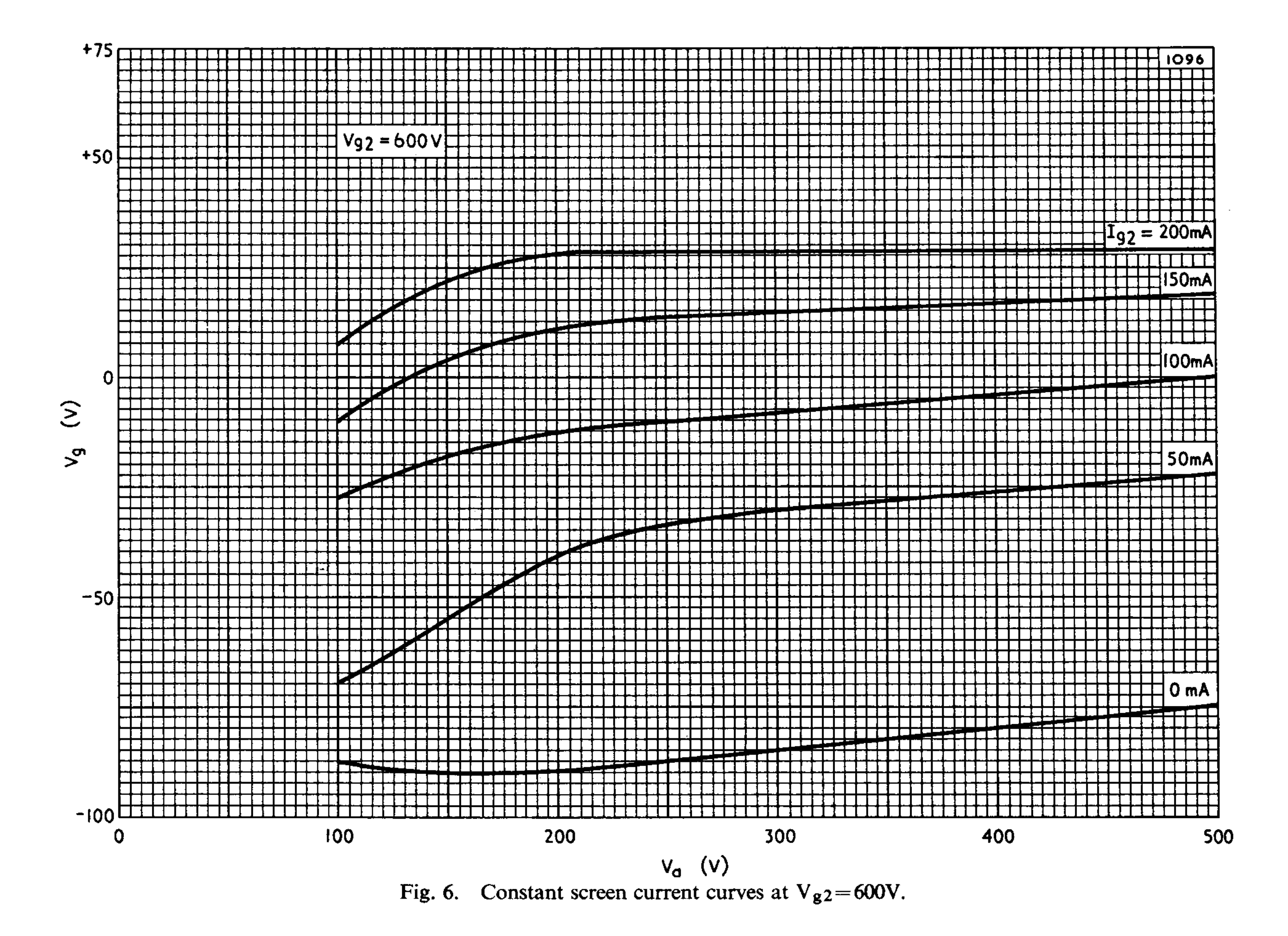


Fig. 6. Constant screen current curves at $V_{g2} = 600V$.

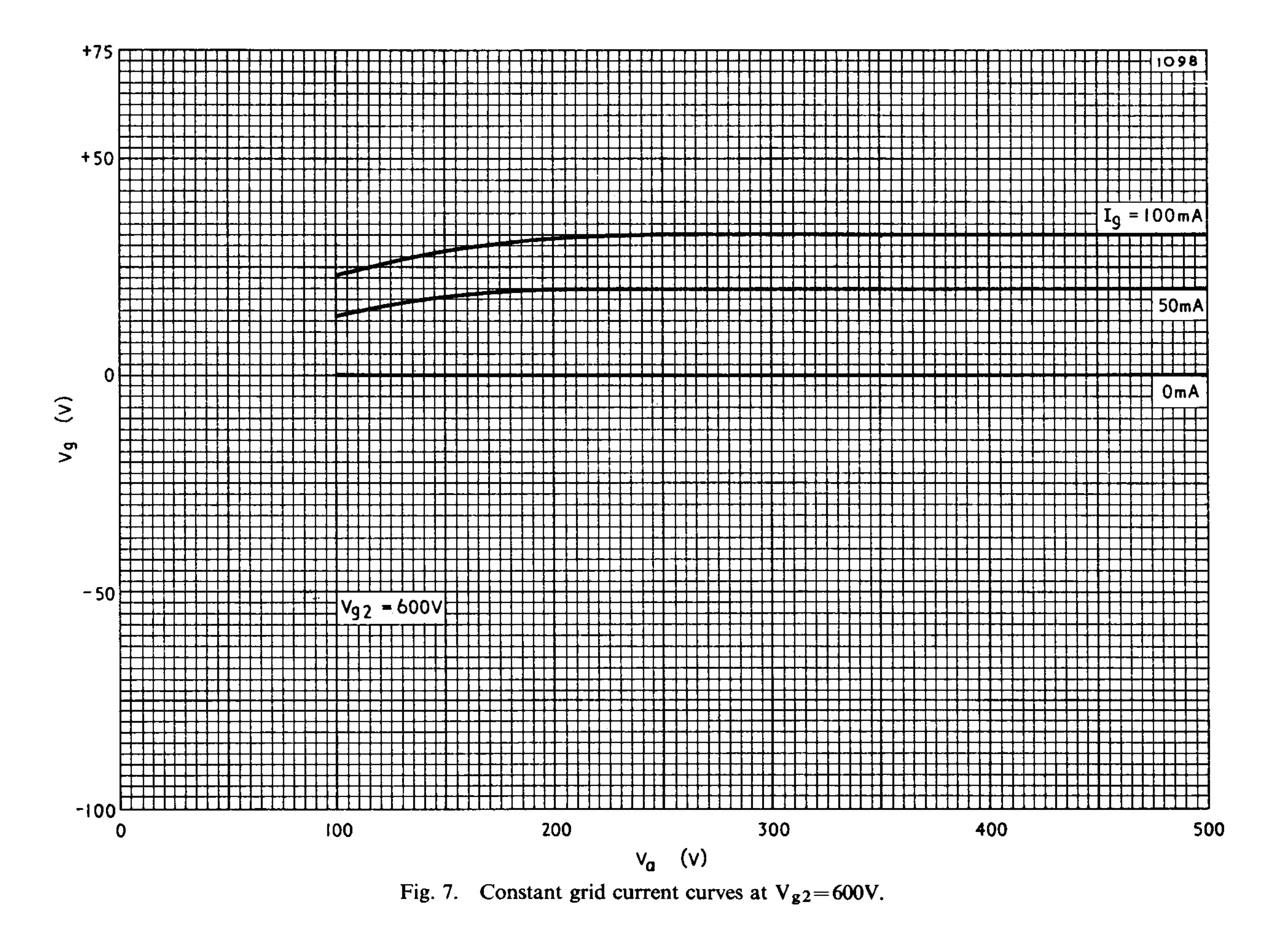


Fig. 7. Constant grid current curves at $V_{g2}=600V$.

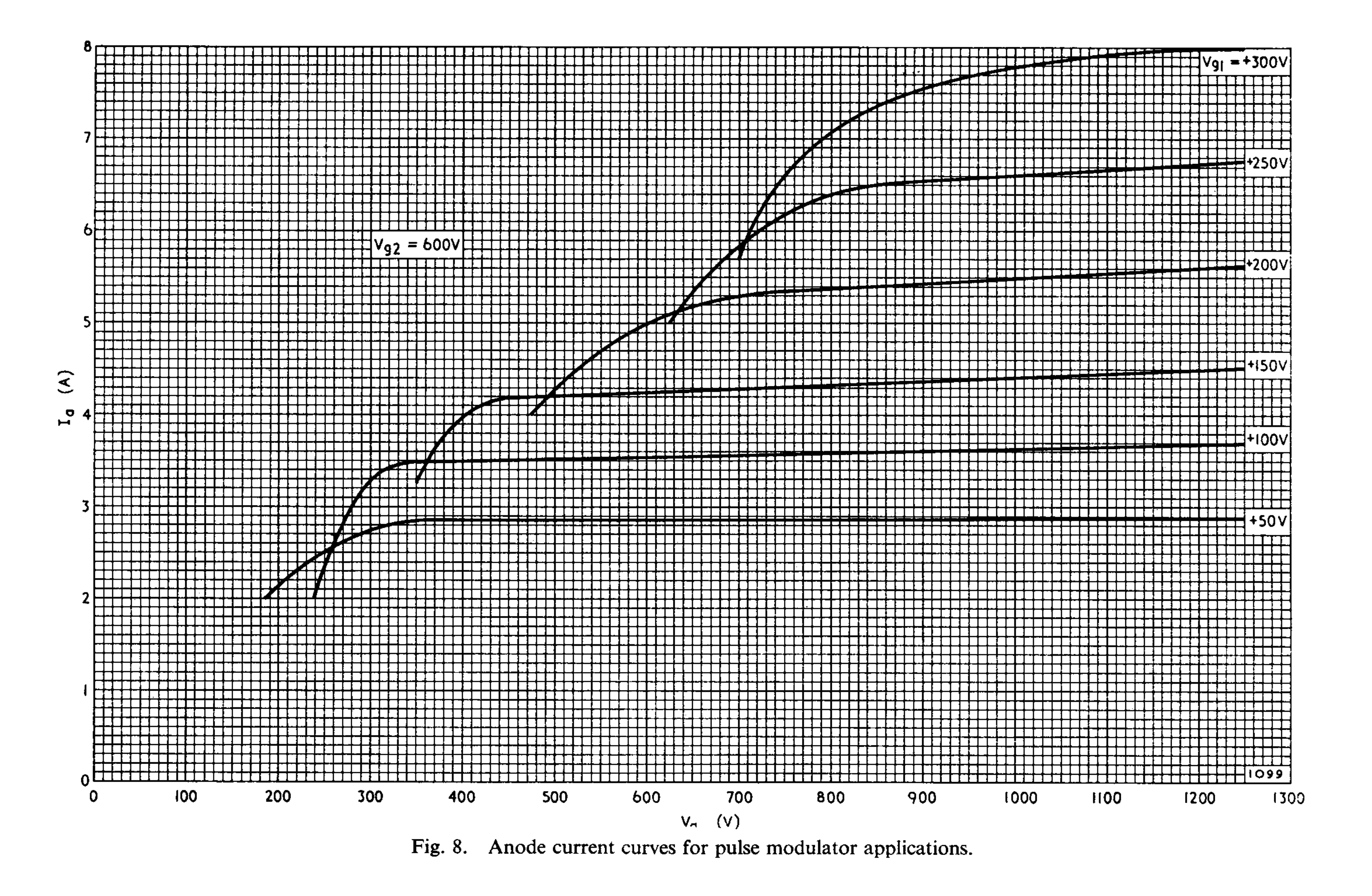


Fig. 8. Anode current curves for pulse modulator applications.

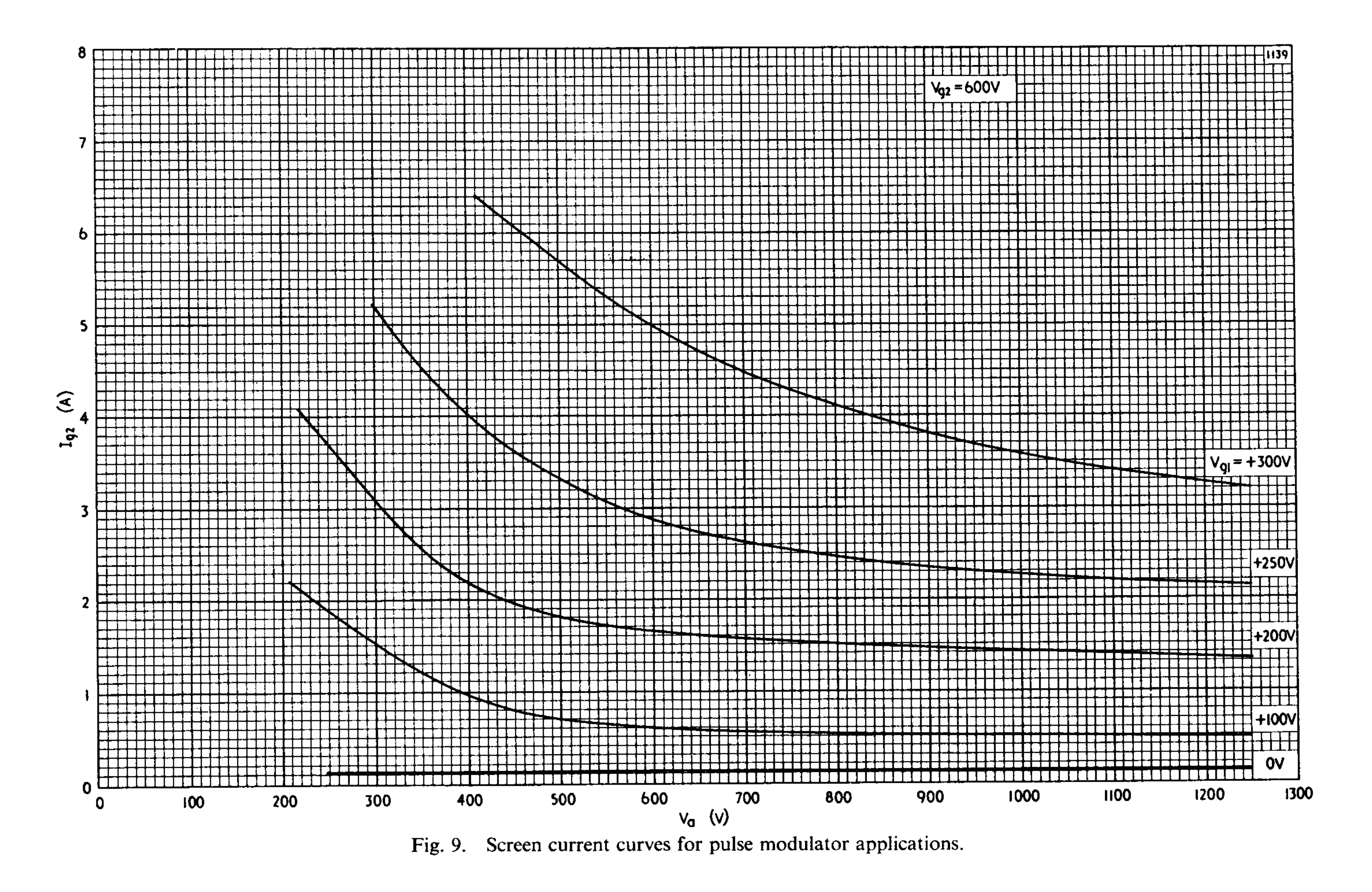


Fig. 9. Screen current curves for pulse modulator applications.

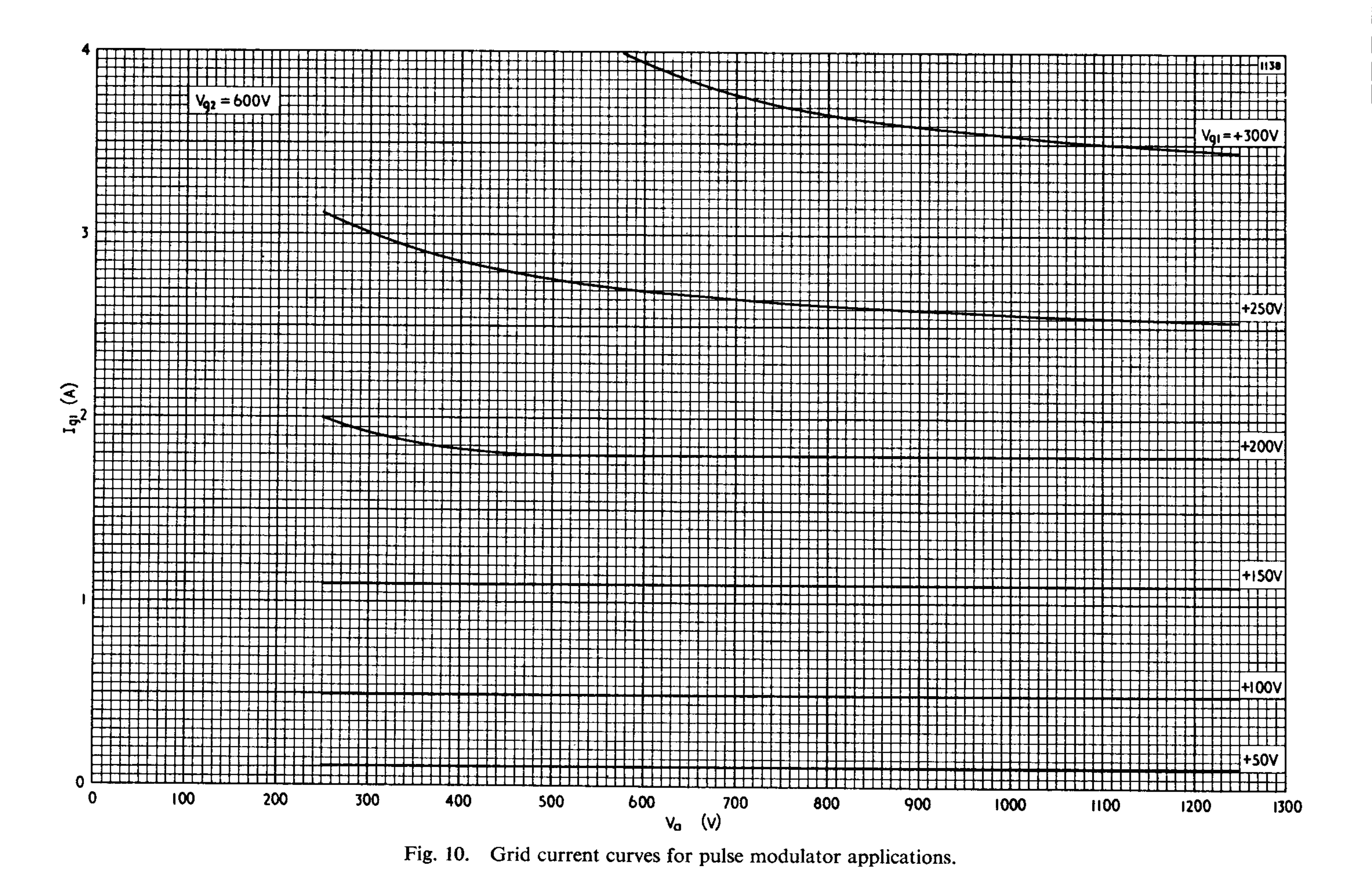


Fig. 10. Grid current curves for pulse modulator applications.

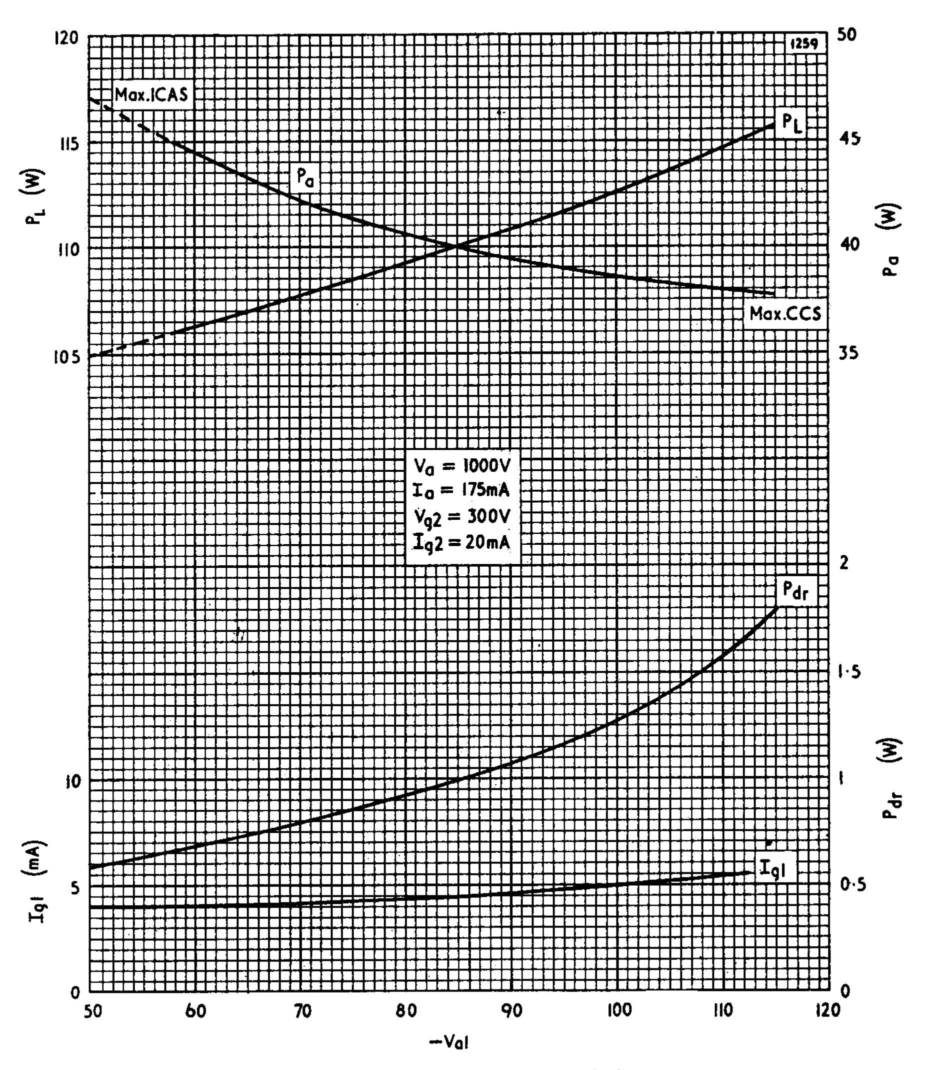


Fig. 11. Class C telegraphy. Bias variation curves.

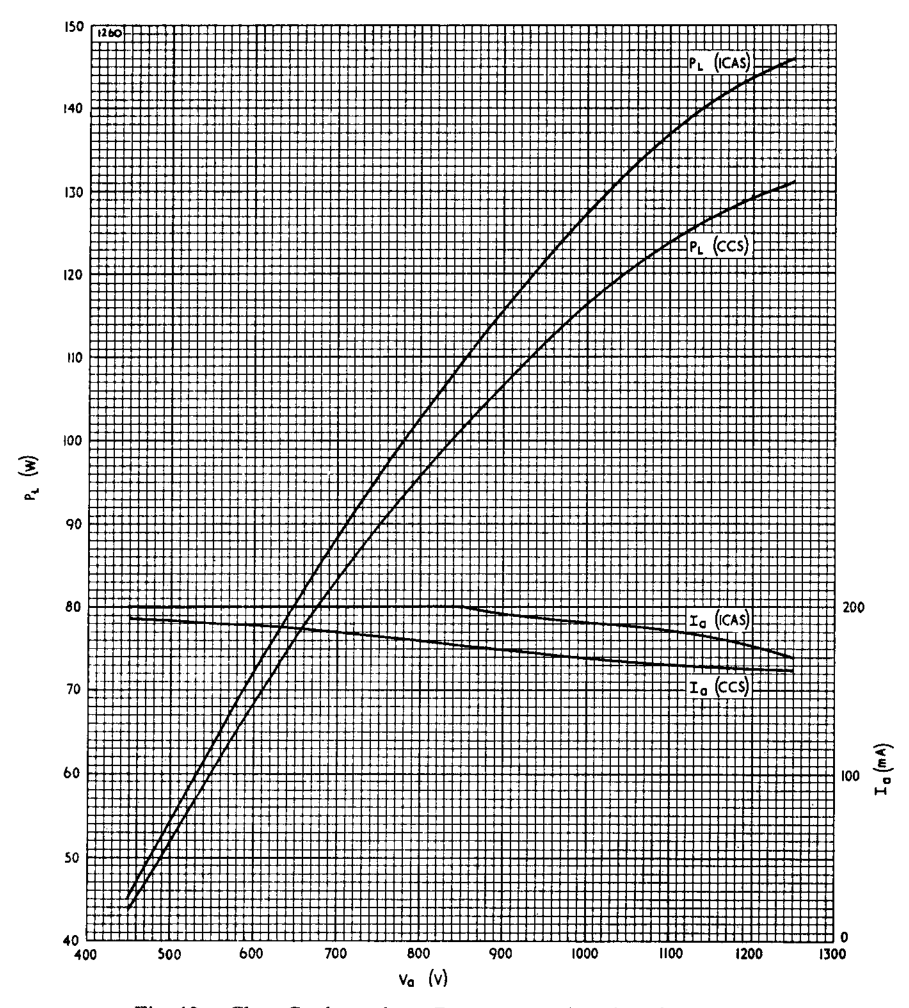


Fig. 12. Class C telegraphy. Power output/anode voltage curves.

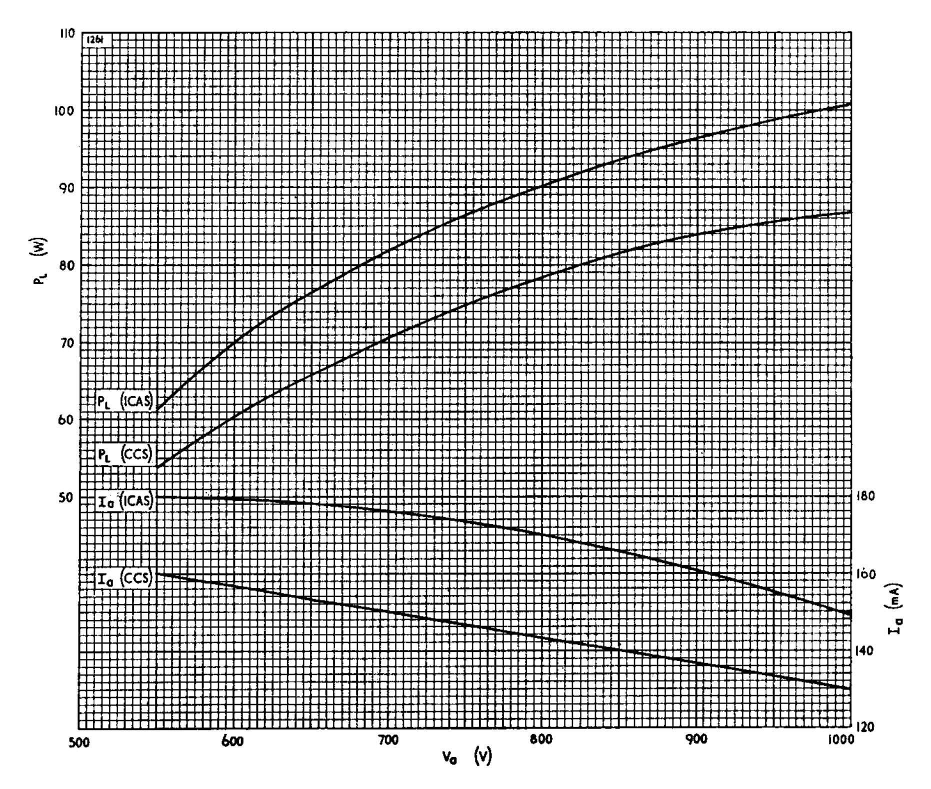


Fig. 13. Anode modulated class C telephony.
Power output/anode voltage curves.

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R645

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